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Indian Standard

SPECIFICATION FOR RESISTANCE WIRES, TAPES AND STRIPS FOR HEATING ELEMENTS

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 2

October 1966

Indian Standard
SPECIFICATION FOR RESISTANCE WIRES, TAPES AND STRIPS FOR HEATING ELEMENTS

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Indian Standard
SPECIFICATION FOR RESISTANCE WIRES, TAPES AND STRIPS FOR HEATING ELEMENTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 19 September 1966, after the draft finalized by the Electrical Appliances Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard covers mainly the mechanical and electrical requirements for resistance wires, tapes and strips used for manufacturing heating elements for electrical appliances. However, the compositions of alloys used in manufacturing heating elements have not been specified because any number of variable alloy types may be obtained due to different additives and heat treatments given during the manufacture of these wires, tapes and strips.

0.3 This standard has been prepared mainly to guide the manufacturers of electrical appliances to procure suitable resistance wires, tapes and strips for making heating elements for electrical appliances.

0.4 While preparing this standard, assistance has been derived from the following:

B.S. 115 : 1954 Metallic resistance material for electrical purposes. British Standards Institution.

ASTM Designation B 344-65 Specification for drawn or rolled nickel chromium and nickel-chromium iron alloys for electrical heating elements. American Society for Testing and Materials.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard specifies general, mechanical and electrical requirements for resistance wires, tapes and strips for heating elements used in light electrical appliances designed for connection to supplies at voltages not exceeding 250 V ac single phase 50 c/s, or dc.

2. TERMINOLOGY

2.1 For the purpose of this standard the relevant definitions given in IS : 302-1973[*] shall apply.

3. MATERIAL

3.1 The relevant provisions of **7.11** and **7.12** of IS : 302-1973[*] shall apply.

NOTE — The nominal compositions of alloys generally employed for manufacture of resistance wires, tapes and strips for heating elements are given below (*see also* IS : 3394-1965[†]):

a) 80 percent nickel, 20 percent chromium
b) 60 percent nickel, 15 percent chromium, 25 percent iron
c) 35 percent nickel, 20 percent chromium, 45 percent iron
d) Iron-chromium-aluminium alloys

4. PHYSICAL AND MECHANICAL PROPERTIES

4.1 Physical Condition — The material shall be in the fully annealed condition.

4.2 Physical Dimensions — The diameters of wires and thickness of tapes and strips shall be according to IS : 1137-1959[‡].

4.3 Maximum Working Temperature — Maximum working temperature for each type of wire, tape or strip shall be as declared by the manufacturer. Recommended temperatures for different alloys are given below (*see also* IS : 3394-1965[†]):

Nominal Composition	*Temperature*
a) 80 percent nickel, 20 percent chromium	1 175°C
b) 60 percent nickel, 15 percent chromium, 25 percent iron	1 100°C
c) 35 percent nickel, 20 percent chromium, 45 percent iron	1 050°C
d) Iron-chromium-aluminium alloys	1 175°C to 1 200°C depending upon the composition of the alloy

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[*] General and safety requirements for household and similar electrical appliances (*fourth revision*).

[†] Method for accelerated life test of electrical resistance alloys for heating elements.

[‡] Thicknesses of sheet and diameters of wire.

4.4 Wires, tapes and strips shall be in the form of round wire, thin tape or strip respectively. They shall be reasonably free from twists, bends, kinks and other flaws and shall be clean and smooth. They shall be of uniform hardness and shall be capable of being closely wrapped cold, without twisting.

4.4.1 The resistance wires, tapes and strips shall be of uniform cross-section throughout their length and the dimensions (that is, diameter in case of round wire; or width and thickness in case of strip or tape) shall not vary throughout their length by more than 1·0 percent.

4.4.2 All strips shall be cut with the edges reasonably parallel and shall be free from curvature.

4.4.3 Resistance wires, tapes or strips shall be one continuous length without any joints in each reel.

4.5 **Tensile Properties** — The tensile strength value, tolerance on this value and percentage elongation shall be as declared.

5. ELECTRICAL PROPERTIES

5.1 **Resistance** — The values of resistance in ohms per metre shall be declared at 27°C and at the maximum operating temperature and at one or more intermediate temperatures. The resistance in ohms per metre at 27°C, marked on the reel, shall not vary from the nominal resistance value declared by the manufacturer by more than the following amounts:

a) *Wires*

Diameter	*Tolerance*
0·56 mm and more	± 3 percent
Less than 0·56 mm to 0·125 mm (inclusive)	± 5 percent
Less than 0·125 mm to 0·05 mm (inclusive)	± 8 percent
Less than 0·05 mm	± 10 percent

b) *Strips and tapes of any thickness or width*

Cold rolled	± 5 percent
Hot rolled	± 8 percent

5.2 **Uniformity of Resistance** — The resistance of any two equal portions of wire taken from the same reel shall not differ by more than 3 percent of the nominal resistance value declared by the manufacturer.

5.2.1 The resistance of any two equal portions of tapes or strips taken from the same reel shall not differ by more than 10 percent of the nominal resistance value declared by the manufacturer.

6. MARKING AND PACKING

6.1 Marking — Each reel of wire, tape or strip shall be indelibly marked with the following:

a) Manufacturer's name or trade-mark;
b) Manufacturer's type or grade of wire;
c) Finish, that is, bright annealed or oxidized;
d) Resistance in ohms per metre at 27°C;
e) Size of wire;
f) Tare weight of reel;
g) Net weight of reel; and
h) Country of manufacture.

6.1.1 Each reel of wire, tape or strip may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

6.2 Packing — The resistance wire, tape and strip shall be firmly wound on cylindrical reels so that it unwinds smoothly without snatches. The reel shall not be completely filled. There shall be a minimum clearance of 1·5 mm from the surface of outermost winding to the edge of the reel. The reels shall be packed in separate, adequate and closed containers.

7. TESTS

7.1 Sampling

7.1.1 From each lot, the percentage of reels as given below, for each test, shall be selected at random and a test sample taken after discarding approximately 1·5 m of wire from each reel:

a) All tests other than endurance test	10 percent
b) Endurance test	2 percent

7.2 Should the test sample selected from any reel not fulfil the test requirements, that particular reel shall be withdrawn. In respect of each failure, two additional test pieces shall be selected from two different reels in a lot and subjected to the test in which the failure occurred. If either of these two test pieces fails to pass the test, each reel in the lot shall be tested and only those reels which fulfil the test requirements shall be accepted.

7.3 Wrapping Test

7.3.1 *Round Wire* — A specimen cut from each reel shall be wrapped round a mandrel of diameter equal to 4 times the wire diameter to form a close helix of 8 turns. Six turns shall then be unwrapped and again closely wrapped in the same direction as before. The wire shall not break.

7.3.2 *Strips and Tapes* — When clamped squarely in jaws, the edges of which are rounded off to a radius equal to the thickness of the tape or strip, the tape or strip shall be capable of being bent cold closely around the jaws four times through an angle of 180 degrees, in addition to a preliminary bend through 90 degrees, without cracking or breaking.

7.4 Tensile Test — This shall be carried out in accordance with IS : 1521-1960* for wire and IS : 1663 (Part I)-1960† for sheet and strip.

7.5 Measurement of Resistance and of Uniformity of Resistance — The measurements shall be made in accordance with IS : 3635-1966 ‡.

7.6 Endurance Test — The test shall be carried out in accordance with IS : 3394-1965§ and the specimen shall have a minimum life of 100 hours.

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*Method for tensile testing of steel wire (Since revised).

†Method for tensile testing of steel sheet and strip: Part I Steel sheet and strip of thickness 0·5 mm to 3 mm (Since revised).

‡Method of test for resistance of metallic electrical resistance material.

§Method for accelerated life test of electrical resistance alloys for heating elements.

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